

The sharp scarps of many of the rhyolite hills do not indicate the action of faults, but are due to erosion.

The sequence of eruptive rocks is suggested.

NOTE.—Specimens lately collected by Mr. R. Speight show that hornblende-andesite with much hypersthene occurs on the north slope of Ruapehu, and also on A Tama. This confirms Hutton's statement. The rock resembles that of Egmont in some respects, but must be scantily distributed on Ruapehu.

Since the above was in type I have received specimens of rock from the Patua Range, north of Mount Egmont, from Mr. N. Cochrane, and others from near Albatross Head, Kawhia, from Mr. R. Browne. In both instances the rocks are similar to those of Mount Egmont, except that pyroxene is entirely absent.

EXPLANATION OF PLATE XIII.

1. Recent and Pleistocene. Sands, gravels, and pumice.
2. Cainozoic. Chiefly Miocene limestones and marls.
3. Mesozoic. Chiefly Triassic shales and sandstones.
4. Rhyolite. Eruption began in Miocene.
5. Hornblende-andesite, Mount Egmont; dacite, Tauhara.
6. Andesites of Cape Colville. Eruption in Miocene.
7. Manukau breccia. Hypersthene-andesites, Miocene.
8. Volcanoes of rhyolite plateau. Hypersthene-andesites, Upper Pliocene to Recent.
9. Dolerite of Pirongia and Karioi (Miocene?).
10. Basanites. Waikato, Auckland, &c.
11. Older basalts of Kerikeri.
12. Diorites and gabbros. Age uncertain.

NOTE.—The map, Plate XIII, is largely based on the work of McKay, Park, and Cox so far as the boundaries of the sedimentary and volcanic rocks are concerned. The author alone is responsible for the boundaries of the different divisions of volcanic rocks.

ART. VI.—*Fossils from Kakanui.*

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Plate XIV.

THE fossils treated of below were collected in 1903, when the author was working at the gem gravels of Kakanui. After a preliminary determination of the species, they were submitted to Captain Hutton, and agreement was reached as to the names. He recommended that the generic names in Zittel's "Text-book of Palæontology" (translation, C. R. Eastman, 1900)

should be uniformly applied, and also that publication should be delayed till his revision of the Tertiary *Brachiopoda* came out.* In the meantime the author removed to England, and found it necessary to send off the manuscript of his paper on the gem gravels of Kakanui† before receiving the revision. Consequently the latter paper, which gives an account of the beds from which the fossils were taken, does not always employ the names to which in the former paper Captain Hutton gives his authority. The necessary corrections will be made by substituting *Terebratula* for *Liothyrina*, and *Terebratulina* for *Notothyris* (on p. 488 *et seq.*), and filling in the new species from those described below.

CORALS.

Isis dactyla, Tenison-Woods.

1880: "Corals and Bryozoa‡ of the Neozoic Period in New Zealand," p. 7, fig. 1.

This species is common in the limestones at Kakanui. Some specimens agree well with the description; the condyles in some cases are more conical than those figured by Tenison-Woods, while others have the condyles depressed, with a small central cone.

Isis hamiltoni, nov. sp. Plate XIV, fig. 1.

Short, thick, cylindrical, often branched, sides irregularly longitudinally striated, sometimes striæ branching; condyle depressed, with a small central cone; radiately striated.

This species seems to be the same as one figured by Duncan.§ With regard to the identification of the genus, he says in another paper,¶ "The calcareous bodies form little trunks or columns varying in height and in the amount of external striation. The branches commence from the calcareous bodies, and not from the horny matter. It is this branching from the calcareous body which distinguishes the genus *Isis* from *Mopsea*, in which the branching starts from the horny substance. Hence, if branching calcareous bodies are found, they may be safely attributed to the first-named genus; but if calcareous bodies with-

* "Revision of the Tertiary *Brachiopoda* of New Zealand," Hutton, Trans. N.Z. Inst., vol. xxxvii, p. 474.

† "The Gem Gravels of Kakanui, with Remarks on the Geology of the District," Thomson, Trans. N.Z. Inst., vol. xxxviii, p. 482.

‡ This was published as part iv of "Palæontology of New Zealand" by the Colonial Museum and Geological Survey Department.

§ Quart. Journ. Geol. Soc., 1875, p. 675, and pl. xxxviii, figs. 1 and 1a.

¶ "On some Fossil *Alcyonaria* from the Australian Tertiary Deposits," *tom. cit.*, p. 673.

out branches present themselves, they may belong to *Mopsea*, or to parts of *Isis* where no branching occurs. Usually, however, the *Mopsea* have extremely slender polyparites, so that probably all stout and simple calcareous bodies belonging to the *Isidineæ* should be classified as belonging to the genus *Isis*."

The specimens now described, being often branched, are therefore placed in the genus *Isis*.

This species differs from *Isis dactyla*, Tenison-Woods, in that the condyles are radiately, not concentrically, striated. It is abundant in the greensands accompanying the limestones at Kakanui.

Graphularia, sp.

Quadrat calcareous axes referable to this genus are frequent in all the limestones of the Oamaru district. They are very similar to *Gr. robinæ*, McCoy.*

BRACHIOPODA.

Terebratula grvida, Suess. Plate XIV, fig. 2.

† 1865: *Waldheimia grvida*, Suess, Reise der "Novara," Palæ., p. 56, pl. ix, figs. 5a and 5b. 1886: *Terebratula*, sp. (figure only), Hector, "Catalogue of the New Zealand Court, Indian and Colonial Exhibition," p. 57, fig. 6. 1905: *Terebratula grvida*, Hutton, Trans. N.Z. Inst., 1905, p. 475.

The larger *Brachiopoda* occurring abundantly in the quarry limestone were originally labelled *W. grvida* by Hutton, as specimens in the Otago Museum show. When, however, in Canterbury, he obtained specimens showing the brachial arms, he hesitated to identify it with Suess's species, and labelled it merely *Terebratula*, sp. The Kakanui shell differs from Suess's description in showing no deltidium, as the thickened anterior wall of the foramen grows forward over the umbo of the dorsal valve. But as Suess's figures show no deltidium and no brachial arms, this identification should hold good.

This species is extremely abundant in the quarry, and occurs in all stages of age. That figured is an old-age form, showing a fold in the dorsal valve. It is not unlike some British oolite species. Younger forms are smoother, the walls of the foramen are not so thickened, and the umbo is more produced.

It also occurs in the the limestone underlying the mineral breccia. At Oamarn Cape the individuals are smaller, and the umbo is more produced.

* Prodrom. Palæ. Viet., Dec. v, p. 32, pl. xlviii, figs. 2-4.

† The references to species in this paper do not have any pretence to completeness. For the sake of brevity, only such are given as bear on the name and priority of the species.

Terebratulina suessi, Hutton. Plate XIV, fig. 5, *a*, *b*, and *c*. 1865: *Terebratulina*, sp., Suess, Reise der "Novara," Palæ., p. 57, pl. ix, fig. 6. 1873: *Terebratella suessi*, Hutton, Cat. Tert. Moll. N.Z., p. 37. 1905: *Terebratulina suessi*, Hutton, Revision, Trans. N.Z. Inst., p. 475.

In the "Novara" palæontology* Suess refers to this species as *Terebratulina*, but in the description of the plate (ix) he calls it *Terebratella*, sp.; and Hutton, in his earlier paper (1873), followed him in this, correcting the genus in 1905. The similarity to *T. scouleri*, Tate, is most marked, and the latter may have to disappear. The ear-like processes on the dorsal valve characteristic of *Terebratulina* have not been noticed in earlier descriptions.

This species is abundant in the quarry limestone, and also occurs in the fossiliferous layers of the Kakanui breccias, as well as on Oamaru Cape.

Photos of the shell, and of the interior of the dorsal valve, showing the loop, are given. The photos show two varieties of shape and ornamentation, between which all intermediate forms may be found.

Magellania sinuata, Hutton. Plate XIV, fig. 3.

1873: *Waldheimia* (?) *sinuata*, Hutton, Cat. Tert. Moll. N.Z., p. 26. 1885: *Terebratella* (?) *sinuata*, Hutton, Quart. Journ. Geol. Soc., 1885, p. 553. 1905: *Terebratella sinuata*, Trans. N.Z. Inst., 1905, p. 478.

Captain Hutton considered these specimens to be the same as his *Waldheimia sinuata*. They agree also with specimens in the Otago Museum labelled by him. They differ, however, from his description in having a deltidium conspicuous, if small, and in having a sharply keeled umbo. The description should, then, read: "Shell orbicular-trigonal, valves subequal; beak very short, umbo keeled; hinge-line angular; deltidium conspicuous. Ventral valve with a broad marginal sinus; dorsal valve convex; margin much sinuated."

There is no evidence that the brachial loops are twice joined to the septum, so the original generic determination is sustained, except that *Magellania* has now replaced *Waldheimia*.

This species is abundant in the Kakanui greensands, and presents considerable variety in form, partly due to crushing. The margins in stout shells are little sinuated. It approaches *M. lenticularis*. Some rather similar shells were considered by Captain Hutton as new, but the amount of material gathered does not justify the description of new species.

* Suess, Reise der "Novara," Palæ., p. 57.

Terebratella kakanuiensis, Hutton. Plate XIV, fig. 4.
1905: Trans. N.Z. Inst., p. 479.

The specimens on which Captain Hutton founded this species were furnished by the author; they were collected from the quarry, North Head, Kakanui.

The following description, prepared before the receipt of Captain Hutton's revision, will simplify in some particulars his description: Broadly ovate; greatest width at middle; slightly longer than wide; valves equally convex, a ridge on the ventral valve, extending from umbo to margin, dividing it into three lobes; dorsal valve with a deep sinus from the centre to the anterior margin; umbo produced and slightly curved, bluntly keeled; foramen large, incomplete; deltidium a small triangular plate on either side. Surface smooth, with inequidistant lines of growth; loop short, reflexed, and doubly attached.

This species differs from *T. rubicunda* in its much deeper dorsal sinus and shorter loop. Captain Hutton considered it the probable ancestor of *T. rubicunda*. It somewhat resembles the figures of *T. woodsii*.*

LAMELLIBRANCHS.

Pecten sectus, Hutton.

1873: *Pecten secta*, Hutton, Cat. Tert. Moll., p. 30. 1886: *Pecten sectus*, Hutton, "Mollusca of the Pareora and Oamarnu Systems of New Zealand," Proc. Linn. Soc. N.S.W., p. 235.

Two types of *Pecten* differing from known species were considered by Hutton to be the young of this species. Their description may be of value:—

(a.) Left valve slightly convex, orbicular-trigonal; angle as long as high; ears unequal; the anterior one with 4 radiating ribs and fine transverse striæ. The whole shell is thrown into 10 plicæ, each dividing at the margin to 2 ribs, the hollows being also occupied by 2 slightly smaller ribs; the ribs spring from the middle zone of the shell; concentric lines of growth; margin crenulate and sinuous. Size, $\frac{3}{4}$ in.

(b.) Right valve flat; shell thrown into 10 plicæ, each splitting into 3 ribs near the bottom, the hollows with 1 rib; surface with very fine concentric striæ, and also oblique striæ.

Cardita benhami, nov. sp.

Shell very convex, subquadrate, slightly inequilateral; 26–30 large radiating ribs, nodulose, a little smaller than the inter-

* Tate, Trans. Phil. Soc. Adelaide, 1880.

spaces; lunule small, cordate; umbones recurved. Height, $\frac{7}{8}$ in.; length, $\frac{7}{8}$ in.

This species differs from *C. australis*, Quoy, as described by Hutton* as *Venericardia australis*, in having always more than 22 ribs. It would, however, be included under the more general description of the same species by G. F. Harris.† He, however, admits several of Tate's Australian species, which do not differ more from *C. australis* than does this variety; hence the foundation of a new species for the purposes of comparison with Australian Tertiary shells is justified. Of these, *C. benhami* resembles most *C. delicatula*, Tate, and *C. granulicostata*, Tate.

The only locality observed was in the fossiliferous layers of the tuff underlying the limestone on the cliffs, North Shore, Kakanui. It is here, however, fairly abundant.

GASTEROPODA.

Turbo marshalli, nov. sp. Plate XIV, fig. 6.

Shell turbate-conical, imperforate; spire depressed, whorls 5-6, convex, acutely keeled; 2 keels on the body-whorl; ornamentation; tubercles on the keel, about 13 to a whorl, but none on the second keel on body-whorl; between keels and upper suture of each whorl are spiral granulose lineations, absent between the keels and the lower suture. Aperture subcircular, entire; outer margin thin. Operculum elliptical.

This species has the same occurrence as the last. It resembles no other known New Zealand *Turbo*.

EXPLANATION OF PLATE XIV.

Fig. 1. *Isis hamiltoni*; natural size.

Fig. 2. *Terebratula grvida*; natural size.

Fig. 3. *Magellania sinuata*; natural size.

Fig. 4. *Terebratella kakanuiensis*; $\times 3$.

Fig. 5. *Terebratulina suessi*; $\times 4$. a, b, two extreme varieties; c, interior of dorsal valve, showing arm-loop.

Fig. 6. *Turbo marshalli*; natural size. a, *Turbo marshalli*; b, side view of operculum; c, face of operculum.

* Cat. Tert. Moll. N.Z.

† Cat. Tert. Moll. Brit. Mus., 1897, part i, Australasia.

